

CHANGE ISSUE – RTCA/DO-242

MASPS for ADS-B

Rev. A

Tracking Information (committee secretary only)	
Change Issue Number	12
Submission Date	1/11/01
Status (open/closed/deferred)	Rev. A – CLOSED
Last Action Date	02/22/02

Short Title for Change Issue:	Request that an aircraft's CDTI and TCAS/ACAS capabilities and TCAS/ACAS RA information be broadcast as part of the ADS-B message Mode Status reports.
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MASPS Document Reference:		Originator Information:	
Entire document (y/n)		Name	Bob Hilb / UPS
Section number(s)		Phone	(502) 359-7396
Paragraph number(s)		E-mail	Bob.hilb@air.ups.com
Table/Figure number(s)		Other	

Proposed Rationale for Consideration (originator should check all that apply):	
<input type="checkbox"/>	Item needed to support of near-term MASPS/MOPS development
X	DO-260/ED-102 1090 MHz Link MOPS Rev A
<input type="checkbox"/>	ASA MASPS
<input type="checkbox"/>	TIS-B MASPS
<input type="checkbox"/>	UAT MOPS
<input type="checkbox"/>	Item needed to support applications that have well defined concept of operation
<input type="checkbox"/>	Has complete application description
<input type="checkbox"/>	Has initial validation via operational test/evaluation
<input type="checkbox"/>	Has supporting analysis, if candidate stressing application
<input type="checkbox"/>	Item needed for harmonization with international requirements
<input type="checkbox"/>	Item identified during recent ADS-B development activities and operational evaluations
<input type="checkbox"/>	MASPS clarifications and correction item
<input type="checkbox"/>	Validation/modification of questioned MASPS requirement item
<input type="checkbox"/>	Military use provision item
X	New requirement item (must be associated with traffic surveillance to support ASAS)

Nature of Issue:	<input type="checkbox"/> Editorial	<input type="checkbox"/> Clarity	<input type="checkbox"/> Performance	X	Functional
<u>Issue Description:</u> The attached comments requesting aircraft's CDTI and TCAS/ACAS capabilities and any current TCAS/ACAS RA crosslink information be broadcast as part of the ADS-B message set were presented to the SC-186 plenary in reference to the ballot on the 1090 MHz ADS-B MOPS (DO-260). It was agreed that these issues would be deferred from consideration in DO-260 until they were first considered for inclusion in a future revision of the ADS-B MASPS. Included with the attached comments is the official response from working group 3, which was charted with development of DO-260.					

<u>Originator's proposed resolution:</u> Proposed resolutions are attached with comments from DO-260 ballot. Also, specific MASPS change proposals related to these topics are found on attachment #2 which was submitted by Capt. Hilb in November, 2000.

Working Group 6 Deliberations:

May 24, 2001: This Issue Paper was discussed by the ad hoc group at their May 2001 meeting. It was agreed that the broadcasting of TCAS and CDTI capability part of this Issue Paper will be addressed in Revision A. However, the request to broadcast TCAS RA information will be deferred unless it can be demonstrated that a mature Operational Concept can be shown. [AI 5-16] Bob Hilb will be asked to brief the group on the work being done on the ACM system.

July 19, 2001: At the July WG6 meeting, this Issue paper was discussed with WG1 during a telecon between the two Working Groups. WG1 (whose chair is the author of this Issue Paper), stated that it was their current position that all that needs to be required of ADS-B is to transmit – when applicable - that the aircraft's ACAS II system is currently issuing a Resolution Advisory. WG6 asked what the receive rate requirements of this information would be. WG1 felt these requirements would be similar to those of the State Vector report, since an ACM system would treat this information as part of the transmitting aircraft's current state. It was agreed that WG4 should be asked to analyze these rate requirements.

August 30, 2001: At the August WG6 meeting, it was agreed to have an on-condition report to transmit the fact that an aircraft currently is experiencing an ACAS II RA. It was further agreed that update rates for this report will be left TBD in DO-242A. These actions will close this Issue Paper for DO-242A.

February 1, 2002: This Issue Paper's final resolution was approved by WG6 as part of the review of 242A-WP-11-01a. The final resolution as it appears in 242A-WP-11-01a appears below. This Issue Paper is now considered CLOSED and addressed in DO-242A.

February 22, 2002: During the February meeting, WG6 approved final MASPS text for this Issue Paper as part of its review of 242A-WP-12-01.

Working Group 6 Final Resolution:

Attachment B of this Issue Paper shows sections 2.1.2.10 and 2.1.2.11 which define Capability Codes and Operational Mode Codes, and sections 3.4.4.9 and 3.4.4.10 which define these CC and OM codes as Mode Status report elements.

**ADS-B 1090 MHz Rev A Comments Related to MASPS Changes
RTCA SC-186 WG-3/EUROCAE WG-51 SG-1**

#	Comment Author	DO-260 Section	Page	Comment / Rationale	Suggested Resolution																				
16	Hilb (2)	2.2.3.2.7.2	94	<p>TCAS RA status is needed for CD&R application</p> <p>WG#3 Position: <i>Before finalizing position, WG#3 will discuss further with Bob Hilb as to why he wants coordination data rather than just own A/C's RA data. (Easier for transponder to access??)</i></p>	<p>Add new section 2.2.3.2.7.2.8A ME bit 48-49, Message bit 80-81 “TCAS RA” Subfield in Aircraft Operational Coordination Msg Add table 2-52A</p> <table><thead><tr><th>Coding</th><th>Meaning</th></tr></thead><tbody><tr><td>00</td><td>No “TCAS RA” Info available</td></tr><tr><td>01</td><td>TCAS is not issuing an RA</td></tr><tr><td>10</td><td>TCAS is issuing a don't climb xlink</td></tr><tr><td>11</td><td>TCAS is issuing a don't descend xlink</td></tr></tbody></table> <p>Change the following as appropriate: Figure 2-9, Sections 2.2.3.2.7.2.9, 2.2.8.2.1, 2.2.8.2.14, 2.2.5.1.33A, 2.4.3.2.7.2.9, A.4.10</p>	Coding	Meaning	00	No “TCAS RA” Info available	01	TCAS is not issuing an RA	10	TCAS is issuing a don't climb xlink	11	TCAS is issuing a don't descend xlink										
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17	Hilb (6)	2.2.3.2.7.3.3.1	98	<p>Table 2-54 – Many of the initial applications depend on the controller and other flight crew knowing if an A/C has an operational CDTI. The CD&R application needs to know if the other A/C has an operational TCAS.</p> <p>Temporary resolution: Changed Table 2-54, initially as suggested by Hilb, but further discussion by Jerry Anderson, Vince Orlando and others during the CPR correction phase after Plenary led to a revision of the meanings as published in the initial 1090 MOPS.</p> <p>WG#3 Position: <i>WG#3 agrees this issue needs addressed in DO-242A. Also, WG#3 has revised the table that is in the published MOPS. To read as follows:</i></p> <table><thead><tr><th>Bit 9, 10, 11, 12</th><th>Meaning</th></tr></thead><tbody><tr><td>0000</td><td>TCAS Not Operational, CDTI Not Operational or unknown</td></tr><tr><td>0001</td><td>TCAS Not Operational, CDTI Operational</td></tr><tr><td>0010</td><td>TCAS Operational, CDTI Not Operational or unknown</td></tr><tr><td>0011</td><td>TCAS Operational, CDTI Operational</td></tr></tbody></table>	Bit 9, 10, 11, 12	Meaning	0000	TCAS Not Operational, CDTI Not Operational or unknown	0001	TCAS Not Operational, CDTI Operational	0010	TCAS Operational, CDTI Not Operational or unknown	0011	TCAS Operational, CDTI Operational	<p>Change Table 2-54 as follows:</p> <table><thead><tr><th>Bit 9, 10, 11, 12</th><th>Meaning</th></tr></thead><tbody><tr><td>0000</td><td>TCAS and CDTI Operational</td></tr><tr><td>0001</td><td>TCAS Operational, CDTI not</td></tr><tr><td>0010</td><td>CDTI Operational, TCAS not</td></tr><tr><td>0011</td><td>Neither CDTI nor TCAS Operational</td></tr></tbody></table> <p>Change the following as appropriate: 2.4.3.2.7.3.3.1, A.4.11.3, Table A-13</p>	Bit 9, 10, 11, 12	Meaning	0000	TCAS and CDTI Operational	0001	TCAS Operational, CDTI not	0010	CDTI Operational, TCAS not	0011	Neither CDTI nor TCAS Operational
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Attachment A
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2.1.2.5 ACAS/TCAS Capability Code

The ACAS/TCAS capability code is used to indicate that ACAS/TCAS is installed and operational.

2.1.2.6 ACAS/TCAS RA Information

The ACAS/TCAS RA information is broadcast whenever an aircraft has a RA in progress. The information broadcast shall include the direction of the RA and the address of the aircraft the RA is against (if known). The information will be broadcast as long as the RA is in progress.

2.1.2.67 Other Information

The ADS-B system shall (R2. 1) be expandable so as to support information transfer requirements for additional applications not specifically identified in this MASPS.

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Proposed MASPS Changes

2.2.3 ADS-B System-Level Performance – ATS Provider Needs for Separation and Conflict Management

Table 2-2 Summary of Information Needs for Applications Supported by ADS-B

Information Element	Aid to Visual Acquisition	Conflict Avoidance and Collision Avoidance	Separation Assurance & Sequencing	Flight Path Deconfliction Planning	Simultaneous Approaches	Airport Surface (A/V to A/V & A/V to ATS)	ATS Surveillance
Identification							
Call Sign ¹	n/r	n/r	R	R	R	R	R
Address	R	R	R	R	R	R	R
Category	n/r	n/r	R	R	R	R	R
State Vector							
Horizontal Position	R	R	R	R	R	R	R
Vertical Position	R	R	R	R	R	n/r	R
Horizontal Velocity	R	R	R	R	R	R	R
Vertical Velocity	R	R	R	R	R	n/r	R
Turn Indication	n/r	n/r	R	R	R	TBD	R
NUC _P , NUC _R	R	R	R	R	R	R	R
Status and Intent ³							
Emergency/Priority Status	n/r	n/r	n/r	n/r	n/r	n/r	R
TCP ²	n/r	n/r	R	R	n/r	n/r	R
TCP+1 ²	n/r	n/r	n/r	R	n/r	n/r	R
Class Code	R	R	R	R	R	R	R
ACAS/TCAS Capability Code	n/r	R	n/r	n/r	n/r	n/r	n/r
ACAS/TCAS RA Information	n/r	R	n/r	n/r	n/r	n/r	n/r
Future Expansion	R	R	R	R	R	R	R

Attachment A
Proposed MASPS Changes

3.4.4 Minimum ADS-B Report Requirements for Equipage Classes

Table 3-6 Mode-status Report Definition

Element #	Contents
1	Participant Address (Section 2.1.2.1.2)
2	Call Sign (Up to 8 Alpha-numeric Characters) (Section 2.1.2.1.1)
3	Participant Category (Section 2.1.2.1.3)
4	Surveillance Support Code(Normal/Default) (note 3)
5	Emergency/Priority Status (Section 2.1.2.3.1)
6	Class Codes (Section 2.1.2.4)
7	TCP Latitude (Section 2.1.2.3.2)
8	TCP Longitude (Section 2.1.2.3.2)
9	TCP Altitude (Baro Alt/FL) (Section 2.1.2.3.2)
<u>10</u>	<u>TCP Validity(Section 2.1.2.3.2)</u>
10 <u>11</u>	TTG (Section 2.1.2.3.2)
11 <u>12</u>	Operational Mode Specific Data
12 <u>13</u>	Flight Mode Specific Data (note 4)
13 <u>14</u>	Time of Applicability (Section 2.1.1.4)
<u>15</u>	<u>ACAS/TCAS Capability Code (Section 2.1.2.5)</u>

Table 3-7 TCP+1 On-Condition Report Definition

Element #	Contents
1	Participant Address (Section 2.1.2.1.2)
2	TCP+1 (Lat.) (Section 2.1.2.3.2)
3	TCP+1(Long.) (Section 2.1.2.3.2)
4	TCP+1 Altitude (Baro/FL) (Section 2.1.2.3.2)
5	TCP+1 TTG (Section 2.1.2.3.2)
<u>6</u>	<u>TCP Validity(Section 2.1.2.3.2)</u>
6 <u>7</u>	Time of Applicability (Section 2.1.1.4)

3.5.1.1.3 Flight Mode/Status Data Input Devices

The subsystem shall interface with the onboard data entry mechanisms such as flight deck keyboards/selectors, certified encoded data sources, and logical discrete inputs to provide the subsystem with the following data.

- Own ICAO Address Data and/or special address
 - Own aircraft address data normally refers to the recognized ICAO 24 bit Address which is provided by an external source(see below) as a fixed input not alterable by

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the crew. However, for some operators desiring anonymity, blocks of 24 bit codes are expected to be available and will require entry for each flight operation.

- Vehicle type code
- Own Flight Identification: the operational flight ID is to be managed by the flight crew
- Own Operational Status Notice: Indicates exceptional operational conditions e.g., hijack, medical emergency, engine out etc. In some cases these data may be crew entered or triggered by on board systems. Mode Information is currently associated with Transponder Air-Ground status of the Aircraft as well as any required or desired annunciation of Emergency Status information. ADS-B support to future automation on other aircraft/vehicles requires expansion beyond present capabilities to meet the operations envisioned in Sections 1 and 2 of this MASPS
- Source participant class codes defining flight-phase capabilities
- [ACAS/TCAS operational status and RA information](#)

3.5.2.1.3 Mode/Status Data Input Devices

The subsystem shall interface with the onboard data base or approved data entry mechanisms such as an flight deck keyboards/selectors, certified encoded data sources, and logical discrete inputs to provide the subsystem with the following data.

- Own ICAO Address Data and/or special address: Own aircraft address data normally refers to the recognized ICAO 24 bit Address which is provided by an external source(see below) as a fixed input not alterable by the crew or other operating personnel. However, for some operators desiring anonymity, blocks of 24 bit codes are expected to be available and will require entry for each flight operation.
- Vehicle type code
- Own Operational Status Notice: Indicates exceptional operational conditions e.g., hijack, medical emergency, engine out etc. In some cases these data may be crew entered or triggered by on board systems. Mode Information is currently associated with Transponder Air-Ground status of the Aircraft as well as any required or desired annunciation of Emergency Status information. ADS-B support to future automation on other aircraft/vehicles may require specialized data from these subsystems.
- Source participant class codes defining flight-phase capabilities
- [ACAS/TCAS operational status and RA information](#)

Fixed obstacle subsystems, B3, require interface only for data to provide receiving participants with a M/S report sufficient to define obstacle identity, type and operational status information.

2.1.2.10 Capability Class (CC) Codes

Capability class codes are used to indicate the capability of a participant to support engagement in various operations. Known specific capability class codes are listed below. However, this is not an exhaustive set and provision should be made for future expansion of available class codes, including appropriate combinations thereof.

- CDTI based traffic display capability (§3.4.4.9.1)
- TCAS/ACAS installed and operational (§3.4.4.9.2)
- Service Level of the transmitting A/V (§3.4.4.9.3)
- ARV capability (§3.4.4.9.4)
- TS report capability (§3.4.4.9.5)
- TC report capability level (§3.4.4.9.6)
- Other capabilities, to be defined in later versions of this MASPS

Note: Capability Class (CC) codes are conveyed in the MS report (§3.4.4 below).

2.1.2.11 Operational Mode (OM) Codes

Operational Mode (OM) codes are used to indicate the current operational mode of transmitting ADS-B participants. Specific operational mode codes are listed below. However, this is not an exhaustive set and provision should be made for future expansion of available OM codes, including appropriate combinations thereof.

- TCAS/ACAS resolution advisory active (§3.4.4.10.1).
 - IDENT switch activated flag (§3.4.4.10.2)
 - Requesting ATC services (§3.4.4.10.3)
 - Other operational modes, to be defined in later versions of this MASPS.
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Table 3.4.4.9: Mode-Status (MS) Report Definition.

		Elements That Trigger Status Change Report		Reference Section	Notes
MS Elem. #	Contents [Resolution or # of bits]				
CC, Capability Codes	7	Capability Class Codes [16 bits]		3.4.4.9	
		7a: CDTI display capability [1 bit]		3.4.4.9.1	
		7b: TCAS/ACAS installed and operational [1 bit]	•	3.4.4.9.2	
		7c: (Reserved for Service Level) [4 bits]		3.4.4.9.3	
		7d: TS report Capability Flag [1 bits]		3.4.4.9.5	
		7e: TC report Capability Level [2 bits]		3.4.4.9.6	
		(CC Codes reserved for future growth) [7 bits]		3.4.4.9.7	
OM, Operational Mode	8	Operational Mode Parameters [16 bits]		3.4.4.10	
		8a: TCAS/ACAS resolution advisory active [1 bit]	•	3.4.4.10.1	4
		8b: IDENT Switch Active [1 bit]		3.4.4.10.2	3
		8c: Requesting ATC services [1 bit]		3.4.4.10.3	
		(Reserved for future growth) [13 bits]		3.4.4.10.4	

3.4.4.9 Capability Class (CC) Codes Field

A transmitting ADS-B participant broadcasts Capability Class (CC) codes (§2.1.2.10) so as to indicate capabilities that may be of interest to other ADS-B participants. The subfields of the CC codes field are described in the following subparagraphs.

3.4.4.9.1 CDTI Traffic Display Capability

The CC code for “CDTI based traffic display capability” **shall** (R3.105-A) be set to ONE if the transmitting aircraft has the capability of displaying nearby traffic on a Cockpit Display of Traffic Information (CDTI). Otherwise, this CC code **shall** (R3.105-B) be ZERO.

3.4.4.9.2 TCAS/ACAS Installed and Operational

The CC code for “TCAS/ACAS installed and operational” **shall** (R3.106-A) be set to ONE if the transmitting aircraft is fitted with a TCAS II or ACAS computer and that computer is turned on and operating in a mode that can generate Resolution Advisory (RA) alerts. Otherwise, this CC code **shall** (R3.106-B) be ZERO.

Note: This field is also contained in the Status Change (SC) Report (§3.4.6). A change in the value of this field will trigger the transmission of messages supporting the SC report (§3.4.6.1).

3.4.4.10 Operational Mode (OM) Parameters

Operational Mode (OM) codes are used to indicate the current operational modes of transmitting ADS-B participants. Specific operational mode codes are described in §3.4.4.10.1 to §3.4.4.10.4 below.

3.4.4.10.1 TCAS/ACAS Resolution Advisory Active Flag

A transmitting ADS-B participant **shall** (R3.112) set the TCAS/ACAS Resolution Advisory Active Flag to ONE in the messages that it transmits to support the MS report so long as a TCAS II or ACAS resolution advisory is in effect. At all other times, the transmitting ADS-B participant **shall** (R3.113) set the TCAS/ACAS Resolution Advisory Active Flag to ZERO.

Note: This field is also contained in the Status Change (SC) Report (§3.4.6). A change in the value of this field will trigger the transmission of messages supporting the SC report (§3.4.6.1).